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Outcomes of Nulliparous Women with Spontaneous Labor Onset Admitted to Hospitals in Pre-active versus Active Labor

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Abstract

Introduction—The timing of when a woman is admitted to the hospital for labor care following spontaneous contraction onset may be among the most important decisions that labor attendants make as it can influence care patterns and birth outcomes. The aims of this study were to estimate the percentage of low-risk, nulliparous women at term who are admitted to labor units prior to active labor and to evaluate the effects of the timing of admission (i.e., pre-active versus active labor) on labor interventions and mode of birth.

Methods—Obstetrics data from low-risk, nulliparous women with spontaneous labor onset at term gestation ($N = 216$) were merged from two prospective studies conducted at three large, Midwestern hospitals. Baseline characteristics, labor interventions, and outcomes were compared between groups using Fisher's exact and Mann-Whitney U tests, as appropriate. Likelihoods for oxytocin augmentation, amniotomy, and cesarean delivery were assessed by logistic regression.

Results—Of the sample of 216 low-risk nulliparous women, 114 (52.8%) were admitted in pre-active labor and 102 (47.2%) were admitted in active labor. Women admitted in pre-active labor

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were more likely to undergo oxytocin augmentation (84.2% and 45.1%, respectively; odds ratio (OR) 6.5, 95% confidence interval (CI) 3.43–12.27) but not amniotomy (55.3% and 61.8%, respectively; OR 0.8, 95% CI 0.44–1.32) when compared to women admitted in active labor. The likelihood of cesarean delivery was higher for women admitted before active labor onset (15.8% and 6.9%, respectively; OR 2.6, 95% CI 1.02–6.37).

Discussion—Many low-risk nulliparous women with regular, spontaneous uterine contractions are admitted to labor units before active labor onset, which increases their likelihood of receiving oxytocin and being delivered via cesarean section. An evidence-based, standardized approach for labor admission decision-making is recommended to decrease inadvertent admissions of women in pre-active labor. When active labor cannot be diagnosed with relative certainty, observation before admission to the birthing unit is warranted.

Keywords

Labor Onset; Nulliparity; Oxytocin; Cesarean Section

INTRODUCTION

The timing of when a woman is admitted to a hospital for labor care following the onset of regular, spontaneous uterine contractions significantly influences the interventions she receives during labor and her birth outcomes.^{1–7} Labor attendants generally aim to admit women to the labor unit after the onset of active labor, that is, when the rate of cervical dilation (cm/hour) is anticipated to increase. Many use criteria in their admission decision process commonly associated with active phase onset, which is suggested to reliably begin between 3 cm and 5 cm dilation, in the presence of regular uterine contractions.^{8,9} Women admitted earlier (e.g., < 4 cm dilation) are approximately twice as likely to be augmented with oxytocin, a “high-alert medication,”¹⁰ when compared to women admitted at more advanced dilatations.^{1,3,5,7} Recent studies of current obstetric populations have found that half of all nulliparous women with spontaneous labor onset receive exogenous oxytocin augmentation.^{11,12} Moreover, cesarean rates following early labor admission are more than twice as high as reference group rates.^{1–5} Among studies reporting specific surgical indications, the incidence of cesarean section for dystocia was higher in earlier admission groups ($P < 0.001$ in each study).^{1,2}

The evidence is clear that admitting women in more advanced labor is associated with decreased oxytocin use and increased rates of vaginal birth. However, differentiating pre-active from active labor based simply on an integer dilation point is likely an inadequate approach. True active labor can only be identified retrospectively based on a determination of progressive cervical dilation over time. Thus, even cervical dilatations of 3, 4, or 5 cm do not validly describe the onset of true active labor for many nulliparous women with spontaneous labor onset.¹³ Zhang et al found that the average labor curve for contemporary nulliparas does not show a clear point of acceleration at any particular dilation.^{11,12} Thus, some women may be in active labor prior to cervical dilatations commonly associated with onset of the active phase. Perhaps of greater clinical importance, a large percentage of nulliparous women are likely admitted to labor units prior to being in active labor and

subsequently managed as though active labor had begun. These women would seemingly be most prone to oxytocin augmentation during labor and to cesarean delivery.

The aims of this study were to estimate the percentage of low-risk, nulliparous women at term gestation who are admitted to hospital labor units prior to the onset of active labor and to evaluate the effects of the timing of admission (i.e., pre-active versus active labor) on labor interventions and mode of birth. We hypothesized that women admitted in pre-active labor are more likely to experience exogenous oxytocin augmentation, amniotomy, and cesarean section.

METHODS

We analyzed obstetrics data merged from two prospective studies. The studies were conducted at three large academic tertiary care hospitals in the Midwest region of the United States. Each institution represented a distinct health care system. More than 4000 women give birth annually at each hospital and the vast majority of labor attendant care is provided by obstetricians. Institutional Review Board (IRB) approval was granted and written informed consents and Health Insurance Portability and Accountability Act authorizations were obtained from all women. Recruitment for the two prospective studies contributing to our dataset for this study took place from April 2007 to February 2008 and March 2011 to December 2012, respectively, and was conducted by the first author or other research team members in the labor and delivery triage unit or in the labor room as soon as possible after admission. All eligible women were approached for participation but only when a research team member was present on the unit. Approximately 70% of approached women accepted participation. The predominant rationale given by women declining participation was to avoid venous blood draws that were part of the prospective study protocols. Blood in the parent studies was drawn to quantify enzymes and inflammatory biomarkers in the maternal circulation following the spontaneous onset of labor.

Participants ($N = 216$) were pregnant nulliparous women of low obstetric risk (i.e., no significant medical history, absence of major pregnancy complications [e.g., pre-eclampsia, diabetes, oligohydramnios, polyhydramnios, non-reassuring fetal status]) admitted by their provider for spontaneous labor onset at term gestation. Eligible women were dilated at least one centimeter at admission but not more than 6 cm and had fetal membranes that were either intact or ruptured for not more than 6 hours prior to labor admission. Labor triage cervical examinations at each hospital were most often performed by resident physicians or staff nurses who would subsequently contact the attending physician or nurse-midwife for an admission decision. Additional eligibility criteria included maternal age of 18–39 years, gestational age of 37–42 weeks, singleton gestation, cephalic presentation, absence of identified fetal anomalies or growth problems, anticipated vaginal delivery, afebrile at study entry, and ability to read and speak English. Women undergoing inductions of labor were not entered into the studies. Care during labor was at the discretion of the labor care providers. Continuous electronic fetal monitoring was the predominant method of fetal assessment.

All digital cervical exams documented by care providers during the course of labor were transcribed post hoc from the labor record so that the average dilation slope during the first 4 hours post admission could be determined. Because cervical exams are rarely performed at exactly 4 hours after the admission exam, slope calculations based on the results of the cervical exams immediately *prior to* and *after* the 4-hour time-point were used to approximate dilatation at the 4-hour post-admission time-point. The average dilation slope (cm/hour) during the first 4 hours post admission was then calculated for each subject. Finally, each subject's labor admission was retrospectively classified as either "pre-active labor" or "active labor," based on the rate of cervical change during the first 4 hours after labor admission using *a priori* criteria. A labor admission was classified as pre-active when average dilation was less than 0.5 cm/hour during the first 4 hours post admission or as active when average dilation was greater than or equal to 0.5 cm/hour. This differentiation cut-point was based on contemporary labor progression research,^{11,12,14–17} with additional consideration for using rates of cervical change that can be reasonably discerned by sequential digital cervical examinations. Demographic data were collected from each subject via interview. Labor intervention and outcome data were extracted from electronic health care records following birth.

The pre-active and active labor admission groups were compared using Fisher's exact tests for binary variables and Mann-Whitney U tests for continuous level data, which all lacked a normal distribution (Kolmogorov-Smirnov test for normality < 0.05), unless otherwise specified. For our directional hypotheses that women admitted in pre-active labor are more prone to oxytocin augmentation, amniotomy and cesarean delivery, one-tailed Fisher's exact tests were used. Finally, labor care pattern (i.e., oxytocin augmentation, use of amniotomy) and mode of delivery were assessed by logistic regression. *P* values < 0.05 were considered significant. Statistical analyses were conducted using SPSS Statistics 19 (IBM Corporation, Armonk, NY).

RESULTS

A total of 322 low-risk nulliparous women were approached for inclusion in the two parent studies, 223 of whom agreed to participate. We excluded two women whose admission cervical dilatations were not within the study eligible range, three women who had fetal membrane rupture more than 6 hours prior to labor admission, one woman whose fetus was determined to be in a breech presentation several hours after admission, and one woman whose cervical exams were not documented throughout labor making group classification impossible. Of the final sample of 216 low-risk nulliparous women, 114 (52.8%) were admitted in pre-active labor and 102 (47.2%) were admitted in active labor. Study participation rates did not differ between those admitted in pre-active versus active labor and the groups did not differ on the number of labor evaluation triage visits prior to admission. As shown in Table 1, there was no significant difference in cervical dilatation at admission between the two groups, although women in the pre-active group were less effaced. Women in the pre-active group had a significantly higher BMI at admission. The groups did not differ on other demographic or labor-related variables at admission.

Particular integer dilatations at admission did not discriminate between pre-active or active labor (see Table 2). While 70% of women admitted at 1 cm ($n = 20$) were in pre-active labor, the proportion of women in pre-active versus active labor was relatively stable from 2 cm forward. Specifically, the percentage of women who were still in pre-active labor following admissions at 2, 3, 4, and greater than or equal to 5 cm were 54.5%, 52.7%, 48.6%, and 45.5%, respectively.

The labor care provided differed between groups (see Table 3). Among women who underwent amniotomy ($n = 126$), those in the pre-active labor admission group had the intervention more remotely from admission compared to those in active labor (3.3 and 2.2 hours, respectively; $P < 0.001$) yet were ruptured for a longer duration of time before giving birth (7.0 vs. 4.6 hours, respectively; $P < 0.001$). However, the pre-active admission group was no more likely to undergo amniotomy than the active admission group (OR 0.8; 95% CI 0.44–1.32). Following amniotomy, maximum temperatures during labor were higher among women in the pre-active labor admission group than in those in the active admission group ($P = 0.026$). Women admitted in pre-active labor were more likely to be augmented with oxytocin (OR 6.5, 95% CI 3.43–12.27).

Women admitted in pre-active labor had in-hospital labor durations lasting on average more than 4 hours longer than those admitted in active labor (11.3 and 7.1 hours, respectively; $P < 0.001$). This difference was primarily accounted for by differences in durations of the first stage of labor.

Cesarean section rates for the pre-active and active labor admission groups were 15.8% and 6.9%, respectively ($P < 0.05$). Accordingly, women admitted in pre-active labor were more likely to be delivered via cesarean section (OR 2.6; 95% CI 1.02–6.37). All cesarean sections performed for the indication of dystocia in the first stage of labor (e.g., “arrest of dilation”; $n = 10$) were experienced by women admitted in pre-active labor. The groups did not differ on other indications for cesarean section. Six of the nine cesarean sections performed for non-reassuring fetal status followed oxytocin augmentation; of these six cesareans, five occurred in the pre-active labor admission group.

DISCUSSION

More than half of the low-risk nulliparous women with regular, spontaneous uterine contractions at term in our study were admitted to the labor unit prior to the onset of active labor. Moreover, no particular integer of cervical dilatation assisted in differentiating pre-active from active labor, which provides evidence that the clinical criteria commonly used as prospective evidence of active labor onset poorly predict true active labor onset (e.g., 3 cm to 5 cm dilatation and regular uterine contractions). These findings reinforce that only adequate cervical change over time (cm/hour) based on at least two appropriately spaced cervical examinations (e.g., 2 to 4 hours apart) reliably differentiates between labor phases for nulliparous women.

The large percentage of nulliparous women admitted before active labor in our study aligns with contemporary reports that cervical dilation rates indicative of active labor do not begin

for many women until the cervix is dilated to 6 cm or more.¹¹ Multiple contemporary research teams have provided data to inform which rates of cervical dilation define normal labor progression. The degree of cervical effacement must also be carefully considered by clinicians making admission decisions since our group and others have found that women in active labor typically have more advanced effacement.^{1,18}

In light of the adverse consequences of early labor admission (e.g., < 4 cm dilatation), including more oxytocin augmentation and cesarean deliveries,¹⁻⁷ the evidence available to standardize an approach for making admission decisions for low-risk, nulliparous women with spontaneous labor onset at term must be critically appraised. We suggest that, in the presence of regular, painful contractions and complete or near complete effacement, it is reasonable to consider admitting a laboring woman at 4 cm or 5 cm dilatation *if immediately preceded by cervical change over time* as determined by sequential cervical examinations (i.e., 1 cm change in 2 hours or 2 cm change in 4 hours) or at greater than or equal to 6 cm regardless of the rate of previous cervical change.

Although our findings provide support that some women begin active labor prior to 4 cm, clinicians must carefully determine whether admitting a woman this early is prudent considering that, before 4 cm dilatation, earlier admission for labor is linearly related to a woman's risk of cesarean delivery.⁵ When a diagnosis of active labor cannot be made with relative certainty, observation before admission to the hospital is warranted. Women requesting admission prior to active labor confirmation should be informed that they may be more likely to receive oxytocin during labor and to be delivered via cesarean. Regardless of a woman's cervical dilatation at the time of admission, clinicians must cautiously differentiate between primary dystocia and inadvertent pre-active labor admission if the rate of cervical dilation is slow in the hours immediately following admission and update their plan of care accordingly.

In a previous study comparing the outcomes of women admitted for spontaneous labor onset at less than 4 cm dilatation ($n = 2,697$) or at greater than or equal to 4 cm ($n = 6,121$), the earlier admission group was more likely to experience a diagnosis of active phase arrest, oxytocin augmentation, cesarean delivery, and other adverse labor outcomes.¹ However, those authors did not compare women admitted in pre-active labor to those admitted in active labor (i.e., many women in the < 4 cm dilatation group may have been actively laboring at admission, while a large percentage in the ≥ 4 cm group may not have been). Similar studies using only a single integer of cervical dilatation to distinguish between latent and active labor have also been conducted.^{2,3} However, comparing labor intervention and outcome differences between women known to be admitted in either pre-active or active labor, as we did in the present study, is more clinically meaningful than basing comparisons on a particular integer of cervical dilatation because the latter approach inadequately differentiates between labor phases.

We speculate, as have others,¹ that more adverse labor outcomes occur to women admitted to hospitals earlier following the spontaneous onset of labor because of increased exposure to the medical system which confers risk not present prior to admission. We also posit that fundamental physiologic differences exist between women in pre-active and active labor

which may, in part, explain differences in labor outcomes. For example, in as much as labor is an inflammatory event requiring maternal peripheral leukocytes to infiltrate and propagate labor events in the reproductive tissues,^{19–21} we speculate that a woman admitted in pre-active labor may be at a less advanced point in the labor-associated inflammatory pathway than a woman admitted in active labor, even if they have the same cervical dilatation. Research aimed at describing physiologic differences between pre-active and active labor admission groups would be a valuable scientific contribution.

There were an increased number of women with a higher BMI in the pre-active labor admission group in our study. Other research teams have found that the progression of labor from 4 cm to 10 cm is slower in obese nulliparous women, particularly before 7 cm dilatation.^{22–24} This is important because maternal obesity has been identified as an independent risk factor for cesarean section in multiple studies, largely due to more diagnoses of slow labor progress.^{25–31} For nulliparous women, cesarean risk increases by 5% for each unit increase in BMI (i.e., 1 kg/m²).³⁰ Although the reason for slower first stage progress among obese women remains largely unknown, it may be appropriate for clinicians to be even more patient when evaluating labor progress among women with a higher BMI.

Exogenous oxytocin was administered to 84.2% of the women admitted in pre-active labor in our study in an effort to accelerate the dilation rate whereas slightly less than 50% of the women in the active admission group received this medication. Rates for both groups are concerning because oxytocin, a “high-alert medication,”¹⁰ is the drug most commonly associated with preventable adverse perinatal outcomes,³² and its misuse is involved in half of all paid obstetric litigation claims.³³ While studies comparing oxytocin use to no treatment are sparse, authors of a recent Cochrane Review reported that early versus delayed oxytocin use resulted in a higher risk of uterine tachysystole associated with fetal heart rate changes requiring intervention (RR 2.51, 95% CI 1.04–6.05).³⁴ This is consistent with our findings in that two-thirds of the women who had cesareans performed for non-reassuring fetal status had exogenous oxytocin augmentation. Oxytocin use is not proven to decrease the number of woman having cesarean sections, the role for which it is primarily used (RR 0.88, 95% CI 0.66–1.19), although early oxytocin use is reported to reduce the mean duration of labor by approximately two hours.³⁴ In our study, women admitted in pre-active labor were on the labor unit more than four hours longer than those admitted in active labor despite being more than six times more likely to receive oxytocin; this has significant cost of care implications, even if vaginal birth is achieved.

Women admitted in pre-active labor were more prone to cesarean section, as hypothesized. All ten cesarean sections performed for the indication of dystocia in the first stage of labor were experienced by women admitted in pre-active labor. Dystocia is the leading indication for primary cesarean deliveries,^{8,35} accounting for approximately half of all cesareans performed in nulliparous women.^{36–39} Based on our findings, it may be possible to significantly decrease the incidence of first-stage cesareans for dystocia by simply delaying labor admission until after the onset of active labor. Additionally, 7 of the 10 cesarean sections performed for dystocia occurred when the woman was less than or equal to 5 cm dilatation. This once again raises concern that many cesarean sections among nulliparous women may be performed prior to active labor ever beginning.^{39,40}

Our study was limited to obstetric data merged from two prospective studies performed 3 years apart. The general labor admission criteria used at the participating hospitals remained unchanged between the two contributing studies although we cannot rule out that some individual providers may have modified their labor admission decision-making over the 3-year span. A second study limitation, common to all labor studies, is that it is nearly impossible to eliminate all confounding factors during labor that may impact labor outcomes (e.g., provider practice differences, support patterns during labor). While it is expected that such factors equally affected the pre-active and active labor groups, this is not definitively known. A larger, randomized trial in a more racially diverse population that evaluates the effects of the timing of admission on labor interventions and mode of birth would be a valuable scientific contribution.

CONCLUSION

Our study provides further evidence that, in the absence of complications, labor attendants in hospital settings should admit low-risk, nulliparous women who are at term to the birthing unit after the onset of active labor. This practice may significantly decrease use of oxytocin and increase rates of vaginal birth. Because active labor can only be determined retrospectively based on an assessment of adequate cervical dilation over time (cm/hour), careful assessment of labor progression *prior* to labor admission must be performed to decrease inadvertent early admissions. We recommend standardizing approaches to labor admission decision-making for low-risk, nulliparous women with spontaneous labor onset and encourage the cautious differentiation between primary dystocia and inadvertent pre-active labor admission in the hours immediately following admission.

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Quick Points

- A large percentage of low-risk nulliparous women with spontaneous contraction onset at term gestation are admitted to labor units before active labor onset.
- Nulliparous women admitted before active labor are approximately twice as likely to be augmented with oxytocin and delivered via cesarean section, when compared to women admitted in active labor.
- Because active labor can only be determined retrospectively based on an assessment of adequate cervical dilation over time (cm/hour), careful assessment of labor progression *prior* to labor admission must be performed to decrease inadvertent early admissions.
- Ample evidence is available to standardize an approach for making admission decisions for low-risk, nulliparous women with spontaneous labor onset in an effort to improve labor safety and birth outcomes.
- When active labor cannot be diagnosed with relative certainty, observation before admission to the birthing unit is warranted.

Table 1Characteristics of Low-Risk Nulliparous Women Admitted in Pre-Active or Active Labor at Term ($N = 216$)

Characteristic	Pre-Active Labor ($n = 114$)	Active Labor ($n = 102$)	<i>P</i>
Maternal age, median (10 th , 90 th percentile), y	26.5 (20.0, 33.0)	26.0 (19.3, 32.0)	0.497
Gestational age at delivery, median (10 th , 90 th percentile), wk	39.6 (37.9, 40.7)	39.7 (38.4, 40.7)	0.447
Race, n (%)			
White	86 (75.4)	83 (81.4)	0.187 ^a
Black	22 (19.3)	11 (10.8)	
Other	6 (5.3)	8 (7.8)	
Marital status, n (%)			
Married	64 (56.1)	65 (63.7)	0.270
Not married	50 (43.9)	37 (36.3)	
Body mass index at admission, median (10 th , 90 th percentile), kg/m ²	30.5 (25.2, 37.3)	29.2 (24.2, 36.6)	<0.05
Cervical dilatation at admission, median (10 th , 90 th percentile), cm	3.3 (1.5, 4.0)	3.5 (2.0, 4.5)	0.144
Cervical effacement at admission ^b , n (%)			
50–75%	26 (22.8)	6 (5.9)	<0.001
80%	88 (77.2)	96 (94.1)	
Fetal station at admission, median (10 th , 90 th percentile)	−2 (−2, −1)	−2 (−2, 0)	0.058
Membrane status at admission, n (%)			
Intact	72 (63.2)	73 (71.6)	0.196
Ruptured	42 (36.8)	29 (28.4)	
ROM duration before admission ^c , median (10 th , 90 th percentile), h	2.1 (1.0, 4.0)	1.7 (0.7, 4.2)	0.082

ROM = rupture of membranes.

Mann-Whitney U tests performed for continuous level data comparisons due to non-normal distributions (Kolmogorov-Smirnov test < 0.05).

Fisher's exact tests performed for categorical level data comparisons unless otherwise specified.

^aChi-square test.^bAlthough percent effacement was not an inclusion/exclusion criterion, no woman was <50% effaced at admission.^cIncludes only women with spontaneous rupture of membranes prior to admission ($n = 71$).

Table 2Proportion of Women in Pre-Active and Active Labor based on Cervical Dilatation at Admission ($N = 216$)

Cervical Dilatation at Admission	Pre-Active Labor ^a ($n = 114$)	Active Labor ^a ($n = 102$)
1 to < 2 cm	14 (70.0)	6 (30.0)
2 to < 3 cm	12 (54.5)	10 (45.5)
3 to < 4 cm	48 (52.7)	43 (47.3)
4 to < 5 cm	35 (48.6)	37 (51.4)
5 to 6 cm	5 (45.5)	6 (54.5)

^aData are n (%)

Table 3

Labor Interventions and Outcome Differences Between Low-Risk Nulliparous Women Admitted in Pre-Active or Active Labor at Term ($N = 216$)

Intervention or Outcome	Pre-Active Labor ($n = 114$)	Active Labor ($n = 102$)	<i>P</i>
Number of cervical exams during labor, median (10 th , 90 th percentile)	7 (5, 11)	5.5 (4, 8)	<0.001
Rupture of membrane (ROM) type, n (%)			
Spontaneous	51 (44.7)	39 (38.2)	0.204 ^a
Amniotomy	63 (55.3)	63 (61.8)	
Time from admission to amniotomy, median (10 th , 90 th percentile), h	3.3 (2.0, 7.3)	2.2 (0.7, 5.3)	<0.001
Time from ROM of any type until birth, median (10 th , 90 th percentile), h	10.0 (4.3, 19.8)	5.7 (2.2, 11.9)	<0.001
Oxytocin augmentation, n (%)			
No	18 (15.8)	56 (54.9)	<0.001^a
Yes	96 (84.2)	46 (45.1)	
Time from admission to oxytocin start, median (10 th , 90 th percentile), h	4.3 (1.3, 10.9)	3.9 (1.0, 9.9)	0.641
Narcotic analgesia used, n (%)	40 (35.1)	27 (26.5)	0.187
Epidural analgesia used, n (%)			
No	4 (3.5)	6 (5.9)	0.522
Yes	110 (96.5)	96 (94.1)	
Time from admission to epidural, median (10 th , 90 th percentile), h	3.8 (1.4, 10.1)	1.9 (0.9, 3.8)	<0.001
Mode of birth, n (%)			
Vaginal ^b	96 (84.2)	95 (93.1)	<0.05^a
Cesarean	18 (15.8)	7 (6.9)	
Indication for cesarean (n)			
Dystocia (1 st stage)	10	0	<0.01
Arrest of fetal descent (2 nd stage)	2	4	0.425
Non-reassuring fetal status	6	3	0.505
Time from admission to complete dilatation, median (10 th , 90 th percentile), h	9.5 (6.8, 17.1)	5.8 (3.5, 9.7)	<0.001
Second stage duration, median (10 th , 90 th percentile), min	79 (37, 194)	69 (28, 199)	0.135
In-hospital labor duration, median (10 th , 90 th percentile), h	11.3 (8.2, 19.3)	7.1 (4.6, 11.9)	<0.001
Maximum temperature during labor 100.4°F, n (%)	14 (12.3)	5 (4.9)	0.090
Infant sex, n (%)			
Female	59 (51.8)	54 (52.9)	0.892
Male	55 (48.2)	48 (47.1)	
Infant weight, mean (SD), g	3453 ± 466	3340 ± 381	0.054 ^c
Infant length, mean (SD), cm	50.1 ± 2.3	49.9 ± 2.2	0.494 ^c
Apgar Scores, n (%)			
<8 at 1 min	13 (11.4)	10 (9.8)	0.826
<8 at 5 min	2 (1.8)	3 (2.9)	0.670
Neonatal admission to NICU, n (%)	4 (3.5)	1 (1.0)	0.373

NICU = neonatal intensive care unit.

Mann-Whitney U tests performed for continuous level data comparisons due to non-normal distributions (Kolmogorov-Smirnov test for normality < 0.05) unless otherwise specified. Fisher's exact tests performed for categorical level data comparisons unless otherwise specified.

^aFisher's exact test (one-tailed) as test of directional hypothesis.

^bIncludes assisted vaginal births (i.e., vacuum or forceps) of which there were 15 and 14, respectively, in the pre-active and active labor admission groups.

^cStudent's *t* test.